SOUTH CAROLINA
SEA GRANT CONSORTIUM

ANNUAL REPORT
1990-1991

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State Budget And Control Board

South Carolina Sea Grant Consortium

287 Meeting Street • Charleston, South Carolina 29401 • (803) 727-2078

Member Institutions
The Citadel
Clemson University
College of Charleston
Medical University of South Carolina
South Carolina State College
South Carolina Wildlife and Marine Resources Department
University of South Carolina

Chairman
Dr. Harry M. Lightsey, Jr.
President, College of Charleston

Executive Director
Margaret A. Davidson

October 15, 1991

The Honorable Carroll A. Campbell, Jr., Governor
The Honorable Members of the South Carolina
General Assembly

Your Excellency, Ladies and Gentlemen:

On behalf of the South Carolina Sea Grant Consortium and its Board of Directors, it is my pleasure to present to you the annual report of the S.C. Sea Grant Consortium for fiscal year 1990-1991, our eleventh year of operation.

We appreciate your continued assistance and cooperation, and look forward to working with you during the next year.

Please do not hesitate to call on us if we can be of service.

Respectfully submitted,

THE S.C. SEA GRANT CONSORTIUM BOARD OF DIRECTORS

Dr. Harry M. Lightsey
Chairman

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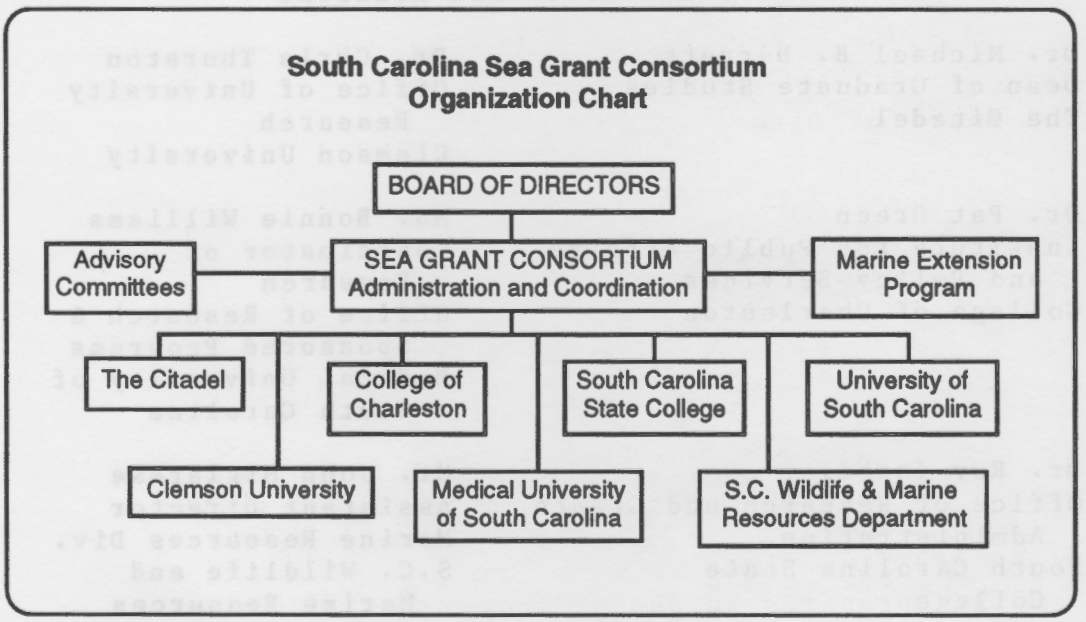


THE SOUTH CAROLINA SEA GRANT CONSORTIUM

Created by South Carolina Act No. 643 in 1978 (amended May 6, 1987, R106, H2331), the principal purpose of the South Carolina Sea Grant Consortium is to provide a mechanism for the development and management of the Sea Grant Program for the state of South Carolina and adjacent regions that share a common environment and resource heritage. The Consortium serves to support, improve and share research, education, training, and extension programs in fields related to ocean and coastal resources. The Consortium further encourages and follows a regional approach to solving problems or meeting needs relating to ocean and coastal resources in cooperation with appropriate institutions, programs, and persons in the region.

Charter Members

The membership of the Consortium consists of the College of Charleston, Clemson University, the Medical University of South Carolina, South Carolina State College, S.C. Wildlife and Marine Resources Department, The Citadel and the University of South Carolina. These members are designated as charter members.

The terms of the membership are perpetual, and a majority of the charter members may vote the admission of a new member into the Consortium.

Board of Directors

The Board of Directors for the Consortium is comprised of the chief executive officer of each of the participating educational institutions and state agencies or his designee.

Executive Director

The Board has the express power to employ the Consortium Director, who has the following powers and duties:

1. directs supervision over all Consortium proposals;
2. prepares Consortium proposals to be submitted to interested agencies;
3. prepares an annual summary of all submitted proposals;
4. negotiates funding levels for proposals submitted by member institutions;
5. provides an accounting to the board of the director's development funds;
6. requests and receives funds from local, state,

federal, and private sources for use by the director, Consortium, individual member institutions, or other persons;

7. gathers, maintains, and makes available to interested persons natural resource information from state and federal agencies, higher education institutions, and any other appropriate entity;
8. designates the location of the consortium office, subject to the approval of the board;
9. exercises all incidental powers necessary to carry out the provisions of this chapter.

Advisory Committee

The Sea Grant Director is to be assisted by an advisory committee which consists of seven members who serve for four-year terms. These seven people, representing private coastal and marine users, are to be appointed to assist the Director with the identification of statewide and regional constituent needs. To date, the advisory committee has yet to be selected and convened.

In addition, six program area advisory groups, consisting of two research professionals, two private sector representatives, and one public offical, assist in the identification of research projects and their incorporation into a cohesive program area package.

OVERVIEW

The South Carolina Sea Grant Consortium is a unique partnership of universities, colleges and one state agency working to promote and implement research, education and extension programs in the sphere of marine and coastal resources. The Consortium accomplishes these concurrent tasks by drawing on the diverse and extensive talents and expertise available at its seven constituent institutions:

* The Citadel
* Clemson University
* College of Charleston
* Medical University of South Carolina
* South Carolina State College
* South Carolina Wildlife & Marine Resources Department
* University of South Carolina

The Consortium is charged with bringing together and coordinating the diverse and extensive talents and expertise of its constituent institutions to assist the state in resolving coastal and marine issues. Three

distinct advantages are realized by this "partnership" mechanism:

* Duplication, often a problem in scientific research, is avoided by encouraging cooperation among the different institutions and among different disciplines within the institutions.

* The promotion of manpower sharing results in greater productivity and lower costs.

* The ability to put together teams of faculty and staff from the various member institutions to help solve problems of concern to the state maximizes the effectiveness of existing personnel at the lowest possible cost. Because of this, the South Carolina Sea Grant Consortium office can operate efficiently with a very small staff.

As an independent state agency, the Consortium has expanded its efforts in marine research programs, educational activities, and technical and extension services: it serves as a "broker" between its member institutions and those individuals, industries, and agencies that can benefit from the results of such a range of programs. The emphasis is placed on applied research based upon the needs identified by potential users; the information gained from Consortium activities is then transferred to those users. In other words, the Consortium acts as an information synthesis and dissemination clearinghouse.

The Consortium is responsible for the administration and management of the Sea Grant Program for the state of South Carolina. The National Sea Grant College Program, signed into law in 1966, awards competitive grants to some 31 coastal and Great Lakes states for the express purpose of accelerating the national development of marine resources, including their conservation, proper management, and economic utilization. It is through research, education and extension work that the objectives of the National Sea Grant College Program are implemented and realized.

The Consortium derives its major funding from several sources -- the state of South Carolina, the National Sea Grant College Program and other federal and private funding sources. Through an annual appropriation from the State, the Consortium receives funding to support the staff, program overhead, and the program development fund. The National Sea Grant College Program Office provides funding primarily for full-scale research, education, and extension service projects. This commitment by both the state and the

federal government in supporting the Sea Grant Consortium is representative of the cooperative nature of the Consortium as it addresses coastal and marine resource issues.

The Consortium is guided in its policy decisions at the state level by its Board of Directors. The Board, which consists of the chief executive officer of each of the Consortium's member institutions, meets regularly to review the Consortium's program and to propose new directions for broadening the scope of its activities.

To facilitate administrative interaction between the Consortium and the faculty and staff of its member institutions, each institution has designated a liaison within its Sponsored Research or Financial Office. These liaisons provide a direct link between investigators and Consortium staff on matters dealing with the proposal process, processing of grants and awards, and oversight of ongoing projects and programs.

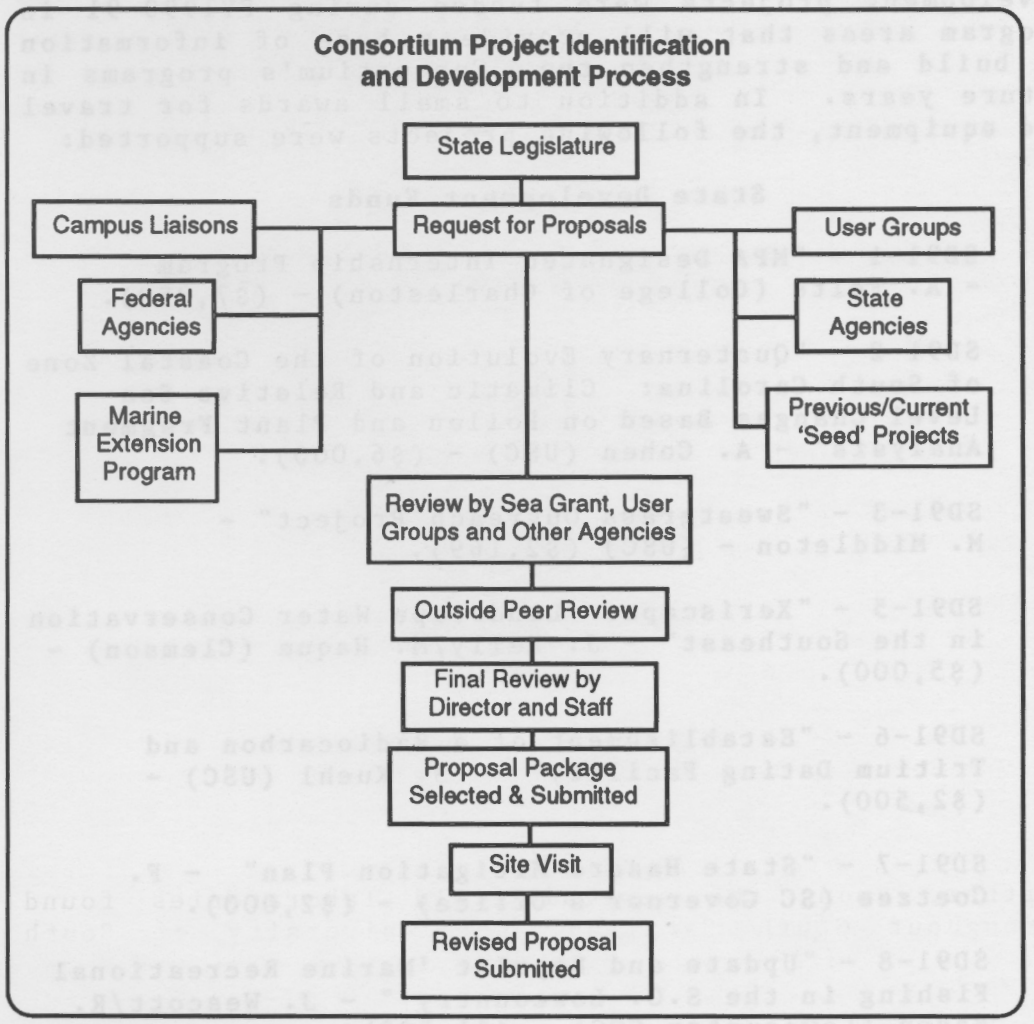
Actual research, education, and extension work on Consortium projects is, of course, carried out by the faculty and staff at the institutions. Their expertise and talent are strengths of the South Carolina Sea Grant Consortium; enabling it to meet the challenge of developing and managing coastal resources in an efficient and comprehensive fashion. Both faculty and staff approach this challenge from the variety of perspectives inherent in their multi-disciplinary fields.

In addition to providing professional expertise in many marine and coastal disciplines, member institutions are able to provide a wide range of facilities for use by Consortium project investigators. These investigators have access to more than 30 research laboratories, including those of the South Carolina Wildlife and Marine Resources Department at Fort Johnson and the James M. Waddell, Jr. Mariculture Research and Development Center in Victoria Bluff, and a large biomedical research facility of the Medical University of South Carolina. Six research vessels are available for field studies. Clemson University possesses the best agricultural engineering facilities for technological development and refinement in the state. Further, among the several field laboratories found throughout South Carolina, the University of South Carolina's 5000 square foot Belle W. Baruch Laboratory in Georgetown County provides a staff of twelve research associates and technicians with a fully equipped facility, including living quarters, and a large conference center.

PROGRAM DEVELOPMENT

General

The South Carolina Sea Grant Consortium has instituted a structured mechanism for its program identification and development process. Program areas are identified by the Consortium staff and program area advisors in consultation with state and federal natural resource agencies, private industry, and Marine Extension Program personnel. The project identification and development process outlined in the chart below is used in the development of the biennial proposal to the National Sea Grant College Program and, generally, for proposals to other funding sources.



For fiscal year 1990-91, the Consortium received some 25 initial proposals in response to its call for proposals. Review of these proposals by qualified professionals from academia, government, and industry throughout the United States via written evaluations and on-site meetings was followed by submission of invited, fully-developed proposals. Fourteen of these proposals were included in the Consortium's FY90-92 biennial proposal package to the National Sea Grant College Program Office for final review and consideration; six proposals were subsequently funded. These are summarized in the next section.

In addition to federal Sea Grant project support, the Consortium Director is provided federal and state program development funds to allow for program flexibility and prompt response to high priority needs, to encourage innovative ideas and approaches, and to provide special support as needs arise. A number of development projects were funded during FY1990-91 in program areas that will provide a base of information to build and strengthen the Consortium's programs in future years. In addition to small awards for travel and equipment, the following projects were supported:

State Development Funds

A. SD91-1 - "MPA Designated Internship Program" - A. Felts (College of Charleston) - ($7,850).

B. SD91-2 - "Quaternary Evolution of the Coastal Zone of South Carolina: Climatic and Relative Sea Level Changes Based on Pollen and Plant Fragment Analysis" - A. Cohen (USC) - ($6,000).

C. SD91-3 - "Sweetgrass Outreach Project" - M. Middleton - (USC) ($2,169).

D. SD91-5 - "Xeriscape: Landscape Water Conservation in the Southeast" - J. Kelly/M. Haque (Clemson) - ($5,000).

E. SD91-6 - "Establishment of a Radiocarbon and Tritium Dating Facility" - S. Kuehl (USC) - ($2,500).

F. SD91-7 - "State Hazard Mitigation Plan" - F. Coetzee (SC Governor's Office) - ($2,000).

G. SD91-8 - "Update and Reprint 'Marine Recreational Fishing in the S.C. Lowcountry'" - J. Wescott/R. Bacon (Lowcountry COG) - ($1,500).

H. SD91-9 - "Charleston Harbor Plume Study - Preliminary Oceanographic Investigations - NOAA Ship FERREL" - J. Blanton (Skidaway Institute)- ($3,000).

I. SD91-10 - "Support for the State Aquaculture Conference Entitled: 'The Atmosphere for Aquaculture in the 1990's'" - R. DeVoe (SCSGC) - ($2,250).

J. SD91-11 - "Enrichment Program for the 1991 for the Lowcountry Science Fair" - W. Kubinec (College of Charleston) - ($1,000).

K. SD91-12 - "Geochemical Studies of Sediment Distribution and Quality in the Charleston Estuary Following Hurricane Hugo" - T. Tisue (Clemson) - ($4,000).

L. SD91-13 - "Terminal Project Proposal" - J. London/ M. Pleasant (Clemson) - ($500).

M. SD91-14 - "World Aquaculture Society Sea Grant Aquaculture Exhibit" - M. Hightower (Texas A&M Sea Grant) - ($300).

N. SD91-15 - "Why Do Some Internal Waves Cause Onshore Transport of Larvae While Others Do Not?" - A. Shanks (College of Charleston) - ($4,700).

O. SD91-16 - "Numerical Modeling" - E. Hayter (Clemson) - ($8,000).

P. SD91-17 - "Support for SC Academy of Sciences Meeting" - A. Hyde (USC-Spartanburg) - ($1,000).

Q. SD91-18 - "Program Printing for Crawfish Festival" - D. Thomas (Festival Director) -($500).

Sea Grant Development Funds

A. P/M-2A (90-91) - "Genetics of the Hard Clam, Mercenaria mercenaria" - J. Hilbish/R. Showman (USC) - ($7,500).

B. P/M-2B (90-91) - "Proteins From Oyster Shells as a Basis for Biodegradable Water Treatment and Super Aborbant Polymers: Part A" - A.P. Wheeler (Clemson) - ($12,000).

C P/M-2D (90-91) - "Chlorinated Phenolic Compounds in the Vicinity of Paper Mills" - T. Bidleman (USC) - ($6,400).

D. P/M-2E (90-91) - "Travel Support for NOAA Ship Ferrel" - T. Tisue (Clemson) - ($1,000).

E. P/M-2F (90-91) - "Publication of 'Shore and Beach'" - R. Wiegel (Editor of "Shore and Beach") - ($500).

F. P/M-2G (90-91) - "Numerical Modeling and Sediment Transport at Tidal Inlets in S.C." - E. Hayter (Clemson) - ($4,000).

G. P/M-2H (90-91) - "Support for the Biopolymers Symposium" - S. Sikes (Univ of South Alabama) - ($1,000).

SEA GRANT PROGRAM DESCRIPTION AND REVIEW

The South Carolina Sea Grant Consortium manages and administers the Sea Grant College Program for the State. As its primary responsibility, the Consortium develops a program that focuses on institutional research, marine education, and marine extension services. Since 1980, the Consortium has administered over $10.5 million in federal and state-appropriated funds for over 245 research, education and extension service projects. For the 1990-91 fiscal year, projects were funded at a combined federal-state level of over $1.0 million. More important, however, are the major economic effects accrued to the state, the region, and, in many cases, the nation from these investments.

Institutional Research

Marine and coastal research programs undertaken by Sea Grant Consortium investigators are categorized into five program areas:

* Living Marine Resources
* Marine Environmental Research
* Coastal Resources Development and Management
* Bioengineering and Marine Technology
* Coastal Processes

During its first five years as a fully operational, independent state agency, the South Carolina Sea Grant Consortium gave preliminary consideration to a wide range of marine related projects. Beginning in FY1985-86, the Consortium's Program Proposal reflected a change in direction and a shift from broad, short-term projects to focused, long-term program areas. This transition implied a commitment to addressing major

needs and concerns of coastal and marine users and managers through objective-oriented, integrated efforts.

This section provides the reader with a brief overview of the 6 fully developed proposals selected, grouped into the five program areas.

Living Marine Resources

The coast of South Carolina includes over 504,000 acres of wetlands and miles of tidal rivers and creeks, which are home to a number of important commercial and recreational species of finfish and shellfish. In addition to providing natural habitat for these important resources, South Carolina coastal waters include many areas in which a variety of species can be raised in aquaculture operations. In both instances, consideration must be given to maintaining high quality habitats, ensuring access to these areas and balancing the needs of fishermen, aquaculturists and other resource users.

The South Carolina Sea Grant Consortium has organized its aquaculture and fisheries research programs under the Living Marine Resources program area in recognition of these mutual needs.

Aquaculture

The development of aquaculture has evolved slowly in the United States as compared to other countries of the world, where aquaculture plays a significant role in their economies. With growing U.S. consumer desire for seafood exceeding domestic supply, the concept of aquaculture has been gaining national attention. This is true for South Carolina where a variety of species, including hard clams, marine shrimp, crawfish, baitfish (minnows), catfish, and striped and hybrid bass, are currently being cultured or examined because of their desirability for aquaculture. The potential for future aquaculture development is greatly enhanced due to the suitability of the climate, physiography, and other features of the state and region.

The South Carolina Sea Grant Consortium has played a pivotal role in developing the State strategy for aquaculture development. Consortium staff coordinated a series of planning meetings and, with the endorsement of the Joint Legislative Subcommittee on Aquaculture, prepared and produced the "Strategic Plan for Aquaculture Development in South Carolina" in January 1989. The Subcommittee has asked the Consortium to oversee the implementation of the Plan's 40

recommendations; an effort that will continue for the next several years.

The South Carolina Sea Grant Consortium continues to aggressively support aquaculture research and extension activities. These efforts directly benefit from the James M. Waddell, Jr. Mariculture Research and Development Center at Victoria Bluff, South Carolina. The Center, which represents a significant commitment by the state to aquaculture, houses state-of-the-art facilities and equipment available to faculty and staff conducting aquaculture research and extension activities. The Consortium works closely with the Center to improve opportunities for the private sector in their aquaculture pursuits.

Hard Clam Genetics Subprogram. The hard clam fishery (Mercenaria spp.) has suffered significant declines in total landings over the last three decades despite high demand and correspondingly high value. Subsequently, the development of hard clam mariculture to supplement the over-exploited fishery has proceeded rapidly and today enjoys considerable commercial development and promise. To achieve economic feasibility, most commercial mariculture operations must rely on extensive field growout procedures for hatchery- and nursery-reared seed. These procedures, while cost effective for large scale operations, allow considerable loss of stock over the average three- to four-year growout cycle. Decreasing total field exposure time during growout would significantly increase economic returns. Growout data from South Carolina indicates that a 25 percent increase in growth rate could decrease field growout time by about eight months. This would make commercial hard clam mariculture much more attractive to investment because time to initial cash flow would be reduced and total return on investment would increase.

Genetic manipulation to produce faster growing cultivated stocks is a reasonable extension of aquaculture research with immediate application to commercial interests. Although some stock improvements in cultured clams have been derived through breeding programs at commercial facilities, no strict application of quantitative genetics to commercial-scale selected breeding has been performed. The potential for genetic improvements in hard clams is great considering their ease of breeding and genetic manipulation, the large variation existing in unselected wildstock, the availability of related species for hybridization, high individual fecundity, and the existence of selected stocks from commercial and research facilities. These attributes, coupled

with results of previous and ongoing studies, indicate that a large and rapid improvement in growth and survival of hard clam stocks through genetic manipulation is within the capabilities of present technology.

The main objective of the Hard Clam Genetics Subprogram has been the development of improved stocks of hard clams suitable for reliable and efficient culture. Secondary goals are the development of technology to improve breeding and culture methodologies, and the accumulation of information on molluscan physiology, genetics, and reproductive biology. This Subprogram proposes to accomplish these goals through an interdisciplinary, multi-institutional approach involving a cooperative research project on the applied breeding of the hard clam, Mercenaria mercenaria.

The final two years of this eight-year project is focused on the completion of the following objectives:

(1) evaluate performance of lines produced in previous grant years,

(2) produce third generation of selected stocks (F_4) and compare with wild and parental (F_1) controls,

(3) determine gametogenic activity and spawning performance of polyploid clam stocks,

(4) develop optimal conditioning windows and gamete storage procedures,

(5) complete genetic survey of wild Mercenaria populations and examine the inheritance of shell morphology,

(6) investigate various archiving schemes and develop a system suitable to the stocks derived from this program,

(7) produce seed for testing in commercial shellfish operations, and

(8) produce technical and extension publications and participate in workshops and conferences to disseminate information derived from this study, in cooperation with the Marine Extension Program.

In addition, research examining the possibility that increases in growth rates in genetic stocks occur through partitioning of energy from reproduction to

growth is being completed. Currently, investigators are attempting to (1) determine gametogenesis and fecundity of cultured stocks, polyploids and hybrids and (2) determine the optimum conditioning window for cultured stocks used in the breeding program.

The program has received considerable direction from meetings of principal investigators with geneticists already working with bivalves (Gary Newkirk, Dalhousie University; Laura Adamkewicz, George Mason University; Richard Koehn, SUNY, Stonybrook; John Crenshaw, Georgia Tech). Principal investigators meet quarterly to evaluate status of the projects and suggest alterations in methodology or direction. A mid-program panel review of the entire program was held in December 1986 to provide outside evaluation of the subprogram. This panel of SCSGC reviewers included Don Squires (University of Connecticut), John Kraeuter (Baltimore Gas and Electric), Laura Adamkewicz (George Mason University) and Dennis Hedgecock (University of California). Program goals and progress in achieving these goals are thus reviewed regularly and revisions made when appropriate. Feedback from projects investigating allozyme variation, reproductive cycles and physiological performance guides the breeding phase of the program in choosing the most advantageous strategies to pursue and in discontinuing strategies which are not proving productive.

The Hard Clam Genetics Subprogram is highly interdependent. The associated projects on allozyme variation, reproductive analyses and physiological assessment could not exist without the breeding project, which produces the lines for analysis. The breeding program's success depends on feedback from those associated projects to evaluate the success of different breeding strategies. In addition to this necessary interdependence, the interdisciplinary approach of the hard clam genetics subprogram assures that considerable information on the physiology, genetics and reproduction of the hard clam will be derived even if none of the breeding schemes successfully produces improved strains. This large body of information will improve our understanding of the biology of bivalves in general and may lead to improved techniques for breeding and culture which will be of value to commercial mariculture and fishery management.

Hybrid Striped Bass Subprogram. The aquaculture of finfish has shown great promise in South Carolina, and has been the source of innovative cooperation between the public and private sectors. Indeed, techniques developed and information derived from South Carolina

Sea Grant support of hybrid striped bass research are now being used by culturists in Maryland, North Carolina, Georgia and other states where hybrid bass culture is permitted. Although these states have been involved with the growth of this industry for many years, it has only been since 1988 that it has been legal to commercially culture hybrids in South Carolina. However, in that short time, eight private growers have developed hybrid operations. This is due in large part to the information and techniques developed over the last six years through Sea Grant.

Considerable interest has been focused on the evidence that N-3 PUFA in marine lipids reduce the risks of cardiovascular disease and have an ameliorating action on other diseases. The fatty acid composition of animal fat can be altered by diet, including that of cultured fish, but to what extent and what effect it has on the health of the fish and its organoleptic quality is unknown.

Under a new two-year project initiated in FY90 by researchers at Clemson University and NMFS-Charleston, the influence of N-3 lipids and N-3:N-6 ratios on the health and post-harvest quality of hybrid striped bass is being examined. Specifically, the proposed study is determining (1) the level of N-3 fatty acids that can be incorporated into hybrids, (2) the effects of N-3 fatty acids and ratios of N-3:N-6 lipids on the physiological well-being of hybrids, and (3) the effects of N-3 and ratios of N-3:N-6 fatty acids on the oxidation, functionality and sensory attributes of the muscle after the dietary treatments and during storage. Defining the nutritional concentration of N-3 PUFA required to produce a healthy, high quality, good-tasting fish would provide the necessary information and guidelines to extend the market potential for hybrids.

Marine Environmental Research

Continued interest in the marine and coastal environment is based primarily on its natural resource potential and economic value. Exploitation of the various resources available along the coast has led to increasing demand and competition for the right and access to those resources. Coupled with increased utilization -- e.g., industrial development, agriculture, shipping, fishing, and recreation -- impacts on the marine environment, in one form or another, are inevitable. Encouraging harmony among all users of the coast and the marine environment must be one of the overall goals of managers responsible for ensuring the wise use and controlled development of the state's natural resources.

The South Carolina Sea Grant Consortium is committed to providing information and data to natural resource agencies and users for use towards minimizing and mitigating environmental effects resulting from these increasing pressures. A major area of concern has been identified by the Consortium - the study of estuarine systems - and forms the basis for the research supported this year.

Estuarine Subprogram

Estuaries of the United States are considered one of the most productive ecosystems in the world: significant economic development depends on the maintenance of high quality estuarine systems. Many commercially- and recreationally-important fisheries species spend at least a portion of their life cycle in estuarine environments. Estuaries serve as buffer zones between freshwater riverine systems and the coastal ocean. They receive and process large inputs of freshwater, sediments, nutrients, and other materials that drain from terrestrial-based watersheds. However, the physical, chemical, and biological processes that control these functions are far from being adequately understood.

At recent symposia designed to develop research strategies and management options for U.S. estuaries, estuarine scientists and managers identified five basic categories of research: water inflows, sediment inflows, nutrients and other chemicals, the coupling of primary and secondary productivity, and fisheries habitat. These areas have been re-emphasized in NOAA's Estuarine and Coastal Ocean Science Framework. The S.C. Sea Grant Consortium has identified priority needs for its Estuarine Subprogram within the research framework established through these sessions.

The primary focus of the Consortium's Estuarine Subprogram is on Charleston Harbor Estuary. Charleston Harbor, formed by the confluence of the Ashley and Cooper Rivers, is part of the second largest watershed on the East Coast (Santee-Cooper Watershed = 16,800 square miles). The Harbor is the site of major military, port, industrial, commercial, resort, and residential activities. It has also been influenced by two major engineering projects: diversion of 80 percent of the freshwater flow out of the system and into the Santee River in 1942; and rediversion of 80 percent of these waters back into the system in 1985. As a result, Charleston Harbor Estuary presents a unique opportunity for the examination of a highly dynamic and heavily impacted system.

The scope of the Estuarine Subprogram has focused on elucidating the physical and biological nature of estuaries. Consortium efforts have been strengthened through collaboration with the NOS Office of Oceanography and Marine Assessment, which has collected data on current and tide fluctuations through the deployment of RADS technology in the Harbor. Additionally, monies provided through the NOAA Office of Ocean and Coastal Resources Management have been supporting several efforts to characterize the biological, physical and chemical attributes of the estuary. Recent Sea Grant studies concentrated on the utilization and diet of estuarine habitat by penaeid shrimp, and the influences of physical processes, such as circulation and dispersion, on biological processes. The Consortium augmented its efforts in FY88-89 by adding two components to further characterize the Charleston Harbor estuarine system. These investigations focus on nutrient dynamics and the response of wetlands to changes in freshwater flow.

Estuarine scientists recognize that physical processes affect species recruitment and habitat utilization, species composition and productivity, nutrient dynamics, sediment transport, and pollutant transport and dispersion. It is therefore extremely important that these physical processes, including their variability, are understood. The final year of a continuing effort completed the characterization of the physical oceanographic conditions in Charleston Harbor. Objectives for the remaining year were to complete the (1) simulation of estuarine responses to changing freshwater flow, rising sea level, tides, and meteorological forcing; (2) measurement, modeling and verification of time and space variations in salinity; (3) identification and characterization of dominant dispersion mechanisms; (4) calculation of material fluxes along the river-estuary system and between the estuary and adjacent wetlands; and (5) estimation of local material sources and sinks along the estuarine salinity gradient. The results of these oceanographic studies in Charleston Harbor Estuary have provided the basis for an improved understanding of the inherent biological and chemical variability in estuarine systems, critical for any attempts to manage the resource and man's impact upon it.

The rapid and continued commercial and residential development around the Charleston Harbor Estuary undoubtedly affects water quality. Human activities and natural processes influence the distribution and dispersion of nutrient elements. The rediversion of the Cooper River with its increased freshwater flow has also modified nutrient inputs. However, little basic

information exists on the nutrient dynamics of the estuary, making it difficult for managers to predict the potential water quality changes associated with increased anthropogenic inputs. A continuing project seeks to develop an ecological-water quality model for the Cooper River portion of the estuary, placing special emphasis on the relationships among river discharge, non-point source loading and river-wetland interactions. Objectives for the study are to (1) develop preliminary models of estuarine water quality dynamics by merging existing information on carbon and nutrient distributions with that on wetland distributions and estuarine hydrography and (2) quantify the functional role of selected watersheds and their dominant wetland habitats in modifying estuarine distributions of water quality parameters. These efforts will lead to the integration of resultant information with existing water quality and estuarine ecology models towards the development of a comprehensive management tool for the estuary.

The Cooper River rediversion has resulted in a reduction in freshwater discharge from 423 to 130 m/s. As a result of reduced freshwater runoff, the isohalines in the Cooper River portion of the estuary have significantly shifted upstream, resulting in a shift in the boundary between fresh and salt water intertidal wetlands. The remaining two years of a three-year study initiated in September 1989 will examine the effects of the changing salinity regime upon intertidal macrophyte wetland communities. The project will (1) develop and apply a salt balance model for intertidal sediments on the Cooper River, (2) determine species composition and biomass of intertidal wetland communities on the Cooper River in relation to the history of freshwater discharge, flood frequency and salt intrusion and (3) determine rates of methanogenesis from intertidal sediments in relation to salinity. The information gained in this project will offer a means of predicting how macrophyte communities will change in response to increased salt water intrusion, and how their productivity will be affected during the transition. It will also provide preliminary information necessary to predict the longer term effects of sea level rise.

Coastal Resources Development and Management

Coastal resource management issues in South Carolina are of the utmost importance to coastal zone planners, managers, developers, and those involved in commerce, industry, recreation, and tourism. The State has an approved Section 306 Coastal Zone Management Program administered by the South Carolina Coastal Council to

encourage the preservation and wise development of coastal and marine resources. The Program seeks to balance the needs of many diverse interests and thereby avoid use conflicts.

The South Carolina Sea Grant Consortium plans to continue examining coastal management issues in cooperation with the S.C. Coastal Council, other management agencies, and coastal user- groups. Research, education, and extension projects dealing with economics, policy, law, regulation, preservation and development of the coast will provide the basis for the development of future Consortium efforts. Needs of the state and region will thus be served simultaneously in terms of coastal decision-making, planning, and assessment.

Bioengineering and Marine Technology

In an increasingly competitive economy, industry spends billions of dollars each year on the research and development of new and better products. Recently, attention has been focused on the exploration of marine sources for these products. Such explorations have been enhanced by the creation of a field of scientific activity called biotechnology. Arising out of new developments in molecular biology and biochemical engineering, advances in biotechnology have allowed scientists and researchers to study biological phenomena as they apply to the manufacturing and service industries. Biotechnology research within the marine environment has focused on the effect of technological processes upon marine organisms and the effect of these organisms and their metabolites upon marine technologies. Already, marine biotechnology research has made significant contributions to the energy, food, pharmaceutical, biomaterial and pollution control industries.

The South Carolina Sea Grant Consortium continues to support research that seeks to advance polymer technologies used in industry that are based upon biodegradable polypeptides.

Coastal Processes

The coastal zone of South Carolina can be divided into three segments. The morphology of the coast is typically represented as a transition zone between the North Carolina and Georgia coastlines. From the North Carolina border to Winyah Bay, the Coast is an arcuate strand, with broad sandy beaches, few inlets, well-developed dunes and sparse salt marshes. It is an area which includes a significant tourism and recreation

industry in Myrtle Beach, and an industrial base in Georgetown. The southern section of the coast is dominated by a series of barrier islands, separated from the mainland by miles of tidal creeks and wide areas of salt marsh. There are few dune systems; rather, tidal inlets are prevalent. Population and industrial growth along this coastal region has remained slow due to these features. However, the numerous barrier and sea islands have attracted vacationers and tourists, and form the hub of the resort industry. The central portion of the coast retains characteristics of both the northern and southern sections; it is also the major permanent population center in the South Carolina coastal zone.

The South Carolina coast is fronted by 159 miles of beach (= 10,000 acres) and 40 barrier islands. As a result of storms, rising sea level, and high rainfall and other natural events, waterfront property is continually subjected to unpredictable erosion and accretion cycles, inlet migrations, and other physical changes. The coast of South Carolina represents an area of primary economic, social, and environmental importance. The South Carolina Sea Grant Consortium seeks, in examining coastal process questions, to address the needs of residents who live and work along the coast by providing information on the natural processes that affect their property and livelihood.

Marine Outreach Programs

Marine Outreach Programs represent the Consortium's overall commitment to provide information to public and private constituents concerning use and management of coastal resources. Projects in education and extension services were the focus of the Consortium's outreach program during FY1990-91.

Marine Extension Program

The South Carolina Marine Extension Program (MEP) was reorganized in 1987 to more effectively provide advisory services to the coastal community. In the restructured program, the South Carolina Sea Grant Consortium continues the cooperative arrangement with the Clemson University Cooperative Extension Service (CES). Program direction and oversight are maintained by the Consortium while CES provides the basic extension personnel and work plans to support general constituent needs. Other more specific needs are addressed through specialist projects within Consortium member institutions. This structure allows the MEP to maintain a core unit of permanent personnel under CES while also having the flexibility to contract experts for specific extension needs.

The Marine Extension Program has defined four primary program areas to respond to coastal user needs:

* economic development and resource management
* aquaculture
* coastal processes
* marine education and information services

Within these areas MEP activities are targeted toward alleviating problems posed by inadequate understanding of coastal resources and appropriate use technologies, as well as hazards inherent to various uses of the coastal environment. Information delivery is closely coordinated with the Consortium's Communications and Information Services program.

The South Carolina Marine Extension Program designs its activities to meet needs of various marine resource users and provides information necessary to ensure wise and effective use of South Carolina's marine resources. Through MEP's identification of needs, related research needs can be addressed in a responsive and efficient manner. MEP cooperative efforts in the development of new technology and provision of extension services to coastal and marine-related businesses will enhance the sound growth of the economy of South Carolina, as well as sustained management of the coastal resources essential to this growth.

Recent program accomplishments include: establishment of a volunteer water quality monitoring program; development of educational materials on estuaries; coordination of marine 4-H camps; preparation of multi-image slide productions entitled "Living on the Edge" and "Crossroads of Change" to improve public understanding of coastal resources and the need for public involvement in development planning and resource management; organization and sponsorship of the South Carolina Aquaculture Forum; preparation of an MEP booklet on coastal regulation and management; participation in the preparation of water conservation projects on Hilton Head Island; development of marine-related classroom activities correlated with objectives of the Basic Skills Assessment Program; extension of a microcomputer-based expert system to evaluate the vulnerability of residential building designs to wind damage; numerous public presentations on marine debris and shoreline protection; assistance with the S.C. Marine Educators Association; and evaluation of new materials for commercial shrimp nets. In addition, the MEP works closely with other Sea Grant programs, the SEMAS network, the National Marine Fisheries Service, other state and federal agencies, and others to provide timely delivery of practical information to various user groups and the general public.

Other Extension Projects

The South Carolina Sea Grant Program has committed significant resources to aquaculture research and development and technology transfer over the last ten years.

For the last six years, the Consortium has supported the development of hybrid striped bass aquaculture. In 1988, under the MEP "Core" project, a four-year hybrid striped bass extension effort was initiated. The primary objective of the effort is the transfer of existing hybrid bass culture technology from the research community to the private sector. Entering its final year, the hybrid bass extension project has developed cooperative programs with eight private farmers in South Carolina, using a combination of on-site training and special workshops. The project (1) provides management recommendations to the eight growers, (2) demonstrates hands-on hatchery procedures, (3) demonstrates pond stocking and harvesting techniques and (4) provides marketing assistance. The effort also involves (1) conducting hybrid bass culture workshops for farmers and extension personnel, (2) preparing extension fact sheets and training videos and (3) summarizing and publishing results of the program.

Communications and Information Services Program

The Communications Program is designed to complement the Marine Extension Program by producing and distributing appropriate information products, attending coastal festivals, and using other public information vehicles that reach coastal constituents. All communications projects attempt to relate the complex and fragile nature of our coastal resources and promote public awareness of important coastal issues and opportunities.

Specific goals of the Communications Program are to: identify specific user groups and respond to their needs with appropriate information products; increase public awareness of Consortium research and the Marine Extension Program; establish consistent and continuous contact with Consortium constituents; improve media familiarity and coverage of the Consortium; and develop support materials for Consortium festival and event appearances.

Examples of CIS activities during FY 1990-1991 include:

Program Awards

The Consortium and CIS earned state and local awards in 1990 and 1991. The publication entitled "Recycle, South Carolina," a joint effort of the Consortium and the Governor's Office, received a Notable Publication Award from the S.C. State Library in recognition of its outstanding design and content. The same publication was also recognized at the local level by the Advertising Federation of Charleston with a coveted Addy Award.

Media Education

The Consortium's Communications Program:

* placed 15 marine science feature stories
* placed 13 radio PSAs
* gave 8 television interviews
* provided 6 radio interviews
* gave 17 newspaper interviews
* contributed to another 13 stories

Economic Development and Resource Management

The Winter 1990-1991 issue of Coastal Heritage was devoted to exploring the topic, "Beyond the Boom: Rethinking Strategies for Coastal Growth" and its Summer 1991 issue to "The New Tourism: Blending Development with Community."

On January 25, 1991, the Consortium held its ninth annual winter conference also entitled "Beyond the Boom: Rethinking Strategies for Coastal Growth," featuring noted architect and planner Andres Duany. Speakers addressed how modern development patterns -- such as urban sprawl -- affect natural resources and culture, and how South Carolina can plan for wiser development. Discussions also included how comprehensive land use plans can contribute to sustainable economic growth along our coastline. The conference was videotaped and made available on VHS to 25 requests from the public.

Coastal Processes

The Fall 1990 issue of Coastal Heritage was dedicated to "Blowing in the Wind: South Carolina's Changing Shoreline" and its Spring 1991 issue to "Estuaries and Growth: Understanding the Connections."

Among publications on coastal processes which the Consortium made available to the public this year were free hurricane checklists and tracking charts which

describe basic emergency supplies and suggestions, and "Restoring and Maintaining South Carolina's Sand Dunes."

On March 20, April 3 and April 17, 1991, the Consortium, along with the Clemson Extension Service, sponsored a series of S.C. Educational Television teleconferences which addressed current natural resource issues before the S.C. General Assembly, including freshwater wetlands, solid waste management and coastal building codes.

Marine Education

Beach Sweep/River Sweep '90 broke new records, with 3,626 volunteers collecting 71,069 pounds of debris, the largest one-day cleanup in the state's history. The event was cosponsored by the Consortium, the S.C. Water Resources Commission and S.C. Clean and Beautiful. Beach Sweep/River Sweep volunteers recorded data on the debris they collected; information which was submitted to a national data bank at the Center for Marine Conservation in Washington, D.C.

The Consortium developed and offered three slide programs on natural resources to community, church and school groups: (1) "Cleaning Up Our Act," outlining the effects of garbage on the environment and how th reduce, reuse and recycle garbage; (2) "Our Valuable Wetlands," which describes the state's vast wetland network and man's effect on them; and (3) "How to Plant a Dune," a description of how to stabilize sand dunes by planting native beach grasses.

"A Guide to Aquatic Field Study Sites in South Carolina," written by Wendy Allen of the Belle W. Baruch Institute (University of South Carolina), was published by the Consortium in April 1991. It is designed to assist individuals and groups locate and use South Carolina's aquatic resources for educational purposes.

Service to Other Public Agencies

The South Carolina Sea Grant Consortium has assisted other public agencies with several tasks during FY90-91. The Executive Director continues to chair the Interagency Advisory Staff of the Joint Legislative Aquaculture Committee, which oversaw the development of the "Strategic Plan for Aquaculture Development in South Carolina," coordinated and published by the Consortium.

The Consortium also provided staff support to the Governor's Freshwater Wetlands Forum, published the Wetlands Forum Report and prepared an educational wetlands slide presentation package. Additionally, the Consortium prepared, produced and published "Recycle South Carolina" in conjunction with the Governor's Office.

In early 1990, the Consortium was asked to participate in the development of a State Hazards Mitigation Plan with the Governor's Office. This activity is still underway.

Other Grants and Activities

The Consortium supports a variety of programs and activities to meet its goal and objectives. Projects undertaken with Sea Grant support represent the core elements of the Consortium's programs. Pass-through grants and extramural projects are initiated to complement the Sea Grant effort at this time; the future of the Consortium lies in its ability to increase its non-Sea Grant program support.

This year, as in the past three years, the Consortium has successfully competed nationwide with the 29 other Sea Grant Programs in the selection of the Sea Grant Federal/Dean John A. Knauss Marine Policy Fellows. Ned Cyr, a graduating Ph.D. student at the University of South Carolina, was the recipient of a coveted fellowship, which offers graduate students training in federal policy regarding marine and Great Lakes natural resources and allows them to apply their skills in the policy-making process.

For fiscal year 1990-1991, the S.C. Sea Grant Consortium obtained funding support from the following organizations for the following activities:

1. **National Sea Grant College Program - NOAA**

   * "Support for Sea Grant Federal Fellows Program/Dean John A. Knauss Marine Policy Fellowship" - Margaret A. Davidson (SCSGC) - $30,000.

   * "Head Start for Science: Expansion of Minority Student Access to Science" - Margaret A. Davidson (SCSGC) - $12,500.

2. **Office of Oceans and Atmospheric Research - NOAA**

* "Continuation of Sediment - Water Interface Studies" - Dr. Thomas Tisue (Clemson) - October, 1990 - NOAA Ship FERREL. Value = $56,000 (approx.)

3. **National Coastal Resources Research and Development Institute - NOAA**

* "Nature-Based Tourism Enterprise: An Alternative for Rural Coastal Economic Enhancement" - Dr. Robert Becker (Clemson) - $31,360.

4. **U.S. Army Corps of Engineers**

* "Support for Conferences on the Effects of Hurricane Hugo" - Margaret A. Davidson (SCSGC) - $4,000.

* "Description of Managed Coastal Wetland Impoundments at the Tom Yawkey Wildlife Center and Santee Coastal Reserve" - M. Richard DeVoe (SCSGC) - $3,500.

5. **S.C. Coastal Council**

* "Public Education Activities in Support of the Charleston Harbor Special Area Management Plan" - Dr. Mel Goodwin (SCSGC) - $15,000.

6. **S.C. Department of Health and Environmental Control**

* "Preparation and Publication of a Document on Non-Point Source Pollution" - Dr. Mel Goodwin (SCSGC) - $10,000.

7. **S.C. Water Resources Commission**

* "Development and Delivery of an Integrated Resources Education Program" - Margaret A. Davidson (SCSGC) - $15,000.

8. **City of Charleston - Commissioners of Public Works**

* "A Study of Impacts Resulting from Pipeline Installation and Mitigation Efforts on Selected Saltmarsh Ecosystem Components in the Ashley River and Wappoo Creek" - Dr. Mel Goodwin (SCSGC) - FY90 - $62,000.

9. Mount Gay Foundation

* "Development of Marine and Coastal Resource Education Materials" - Margaret A. Davidson (SCSGC) - $5,000.

10. Private Funds (misc.)

* "Determination of the Distribution, Abundance, and Status of Colonial Nesting Waterbirds in South Carolina" - Mr. Thomas M. Murray and Mr. Philip M. Wilkinson (SCWMRD) - FY89 - $7,875.

* "Hybrid Striped Bass Aquaculture Demonstration Project" - Dr. Ted Smith (SCWMRD) - $24,485.

* "Support for the Harborwatch Volunteer Monitoring Program" - Dr. Mel Goodwin (SCSGC) - $1,500.

EFFICIENCY AND EFFECTIVENESS MEASURES

The South Carolina Sea Grant Consortium, in accordance with the requirements of Act 189, Section 129.50, have developed the following efficiency and effectiveness measures. Insomuch as the requirements were established in Proviso 129.50 of the FY89-90 Appropriations Act, and their development was requested in December 1989, complete data are not available for comparisons of performance.

Overall Mission Statement

To develop, support, improve and coordinate research, education, training and extension efforts that enhance the economic development, proper management and conservation of coastal and marine resources in the State and region, through administration of the Sea Grant Program and in cooperation with appropriate institutions, programs and persons in the region.

Program Title:

Administration

Program Performance Measures:

Effectiveness:

1. Contacts made through mass media efforts in FY90-91 over previous years.

Performance:

Number of Media Placements (FY90-91)	= 172
Number of Media Placements (FY89-90)	= 219
Number of Media Placements (FY88-89)	= 152

2. Public school science teachers and students exposed to and/or using marine education materials in FY90-91 over previous years.

Performance:

Number of Teachers/Students (FY90-91)	= 3,312
Number of Teachers/Students (FY89-90)	= 1,726
Number of Teachers/Students (FY88-89)	= 1,108

3. Requests for information received by Consortium during FY90-91.

Performance:

Requests for information (FY90-91)	= 7,205

4. Number of and enrollment at MEP workshops and demonstrations during FY90-91 compared to previous years.

Performance:

Number of Workshops (FY90-91)	= 257
Attendees (FY90-91)	= 14,660
Number of Workshops (FY89-90)	= 85
Attendees (FY89-90)	= 7,500

5. Sea Grant project proposals reviewed by the National Sea Grant College Program Office that are deemed technically and conceptually sound in FY90-92 compared to previous biennial cycles.

Performance:

Percent of Proposals (FY90-92)	= 88.9%
Percent of Proposals (FY88-90)	= 81.3%

6. Investigators, professionals and students supported through Sea Grant research, extension and education projects in FY90-91 compared to previous years.

Performance:

Number of	Investigators (FY90-91)	= 32
	Professionals (FY90-91)	= 5
	Students (FY90-91)	= 19
Number of	Investigators (FY89-90)	= 22
	Professionals (FY89-90)	= 14
	Students (FY89-90)	= 24
Number of	Investigators (FY88-89)	= 24
	Professionals (FY88-89)	= 18
	Students (FY88-89)	= 20

7. Percentage change in non-state program budget (research, extension and education activities) in FY 90-91 over previous year.

Performance:

Non-State Funds (FY90-91)		= $1,031,220.
% Change	= +9.3%	
Non-State Funds (FY89-90)		= $ 935,305.
% Change	= +5.5%	
Non-State Funds (FY88-89)		= $ 883,700.

Efficiency:

1. Ratio of state financial support to total financial support.

Performance:

Ratio (FY90-91)	= 33.4%
Ratio (FY89-90)	= 35.0%
Ratio (FY88-89)	= 34.9%

2. Average cost per constituent contact (based on the ratio of costs and distribution of publications to the cost of the Communications program).

Performance:

Cost per Constituent (FY90-91)	= $0.93
Cost per Constituent (FY89-90)	= $0.90

FISCAL REPORTS

Contents

Exhibit A

S.C. Sea Grant Consortium
Balance Sheet
June 30, 1991

Assets			Liability and Fund Balance		
Current Funds:			Current Funds:		
Cash on hand	$ 200		Unrestricted	$	
Prior year refund	971		Prior year refund	971	
State Treasurer	3,567		Due to State General Fund	3,767	
		$ 4,738			$4,738
Restricted Funds:			Restricted Funds:		
Due from Grantors	32,735		Revenue	114,579	
State Treasurer	114,579		Deferred Revenue	32,735	
		147,314			147,314
Total Funds		$152,052	Total Funds		$152,052
Fixed Assets			Fixed Assets Funds		
Equipment Inventory	134,388		Funds Balance	134,388	
Total Fixed Assets Funds		$134,388			$134,388

Exhibit B

S.C. Sea Grant Consortium
Statement of Changes in Current Operating Funds
Year Ended June 30, 1991

	Administration
Balance July 1, 1990	$ 200
Additions:	
Original Appropriation	519,844
Salary & Fringe Benefits Adjustments	5,001
Total Additions	524,845
Deductions:	
Expenditures	514,525
Personal Service Reduction	2,435
Travel Reduction	1,284
Equipment Reduction	165
Agency Base Reduction	2,281
Mid Year B&C Mandated Reduction	588
Total Deductions	521,278
Balance Due to the General Fund	$ 3,767

Exhibit C

S.C. Sea Grant Consortium
Statement of Changes in Restricted Funds
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Sea Grant Contracts	$	$	$	$
1986-87		4,110	4,110	
1987-88	<1,774>	18,013	16,239	
1988-89	<6,913>	14,638	7,725	
1989-90	24,436	349,075	373,511	
1990-91		438,783	438,783	
Other Federal Funds	< 678>	21,813	21,135	
Other Restricted Funds	179,474	47,173	112,068	114,579
Totals	$194,545	$893,605	$973,571	$114,579

Exhibit D

S.C. Sea Grant Consortium
Statement of Changes in Fixed Assets
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Capital Equipment	$114,058	$11,404	$ 4,578	$120,884
Motor Vehicle Equipment	25,624		12,120	13,504
Totals	$139,682	$11,404	$16,698	$134,388

Exhibit E

S.C. Sea Grant Consortium
Notes to Financial Statements
June 30, 1991

Note 1 - Summary of Significant Accounting Policies

Basis of Accounting:

The financial statements have been prepared on an accrual basis.

Funding Accounting:

To ensure observance of limitations and restrictions placed on the use of resources available to the Consortium, the accounts are maintained in accordance with the principles of fund accounting. This is the procedure by which resources for various purposes are classified for accounting and reporting purposes into funds that are in accordance with specified activities or objectives. Separate accounts are maintained for each fund.

General Fixed Assets:

Fixed assets are recorded as expenditures of the general operating fund upon acquisition and subsequently capitalized at actual cost in the general fixed asset account group. In accordance with generally accepted accounting principles prescribed for governmental funds, a provision for depreciation of general fixed assets is not recorded.

Grant Accounting:

The Consortium is a State agency involved in ocean and coastal research, education, and advisory extension work. It serves to encourage, coordinate and facilitate projects pertaining to coastal and ocean areas of South Carolina and to utilize the talents of its members to address marine issues and opportunities.

The Consortium identifies these projects through planning and priority setting exercises. The Consortium arranges for the design and implementation of the projects, usually through its member institutions. On a biennial basis, core projects are submitted to the National Sea Grant Program for funding. Additionally, the Consortium submits project proposals to federal, state and private funding agencies for consideration and support. A majority of the projects funded are then subcontracted to various member institutions.

Expenditures paid by the Consortium at June 30 and not yet reimbursed by the primary grantor are recorded as accounts receivable. Revenues received on specific grants which are in excess of expenditures are recorded as deferred revenues.

Note 2 - Retirement Plan

Substantially all employees of the Consortium are covered by a retirement plan through the South Carolina Retirement System. It was not feasible to separately identify current year retirement plan cost included as a portion of employer contributions in the accompanying financial statements.

Information regarding the excess, if any, applicable to the Consortium of the actuarially computed value of vested benefits over the total of the pension fund and any balance sheet accruals, less any pension prepayments of deferred charges is not available. By State Law, the Consortium's liability under the retirement plan is limited to the amounts appropriated therefore in the South Carolina Appropriation Act, plus the amount paid from other revenue sources for the current year. Accordingly the Consortium recognizes no contingent liability for unfunded costs associated with participation in the plan.

Note 3 - Contingent Liabilities

The Consortium has numerous contracts with the Federal Government, other State agencies and other funding sources for the reimbursement of specific costs related to the various programs described in each contract. Reimbursement costs subsequently deemed to be unallowable by the grantor, if any, would have to be repaid. A majority amount of the contracts are in turn subcontracted by the Consortium and reimbursed costs deemed to be unallowable would result in a claim by the Consortium against the subcontractor.

Note 4 - Changes in General Fixed Assets

Changes in general fixed assets for the year ended June 30, 1991 are as follows:

	Balance 7/1/90	Additions	Deletions	Balance 6/30/91
Equipment	$139,682	$11,404	$16,698	$134,388

Schedule I

S.C. Sea Grant Consortium
Schedule of Current Unrestricted Expenditures
Year Ended June 30, 1991

Title	Original Appropriations	Revised Appropriations	Expenditures	Balance
Personal Services	$ 277,129	$ 253,230	$ 250,184	$3,046
Contractual Services	62,184	50,415	50,388	27
State Development	40,000	50,952	50,952	-0-
Supplies	15,130	19,044	19,044	-0-
Fixed Charges	50,938	60,225	60,225	-0-
Travel	12,933	22,634	22,618	16
Equipment	1,000	599	598	1
Light, Power, Heat	4,500	4,211	4,113	98
Transportation	2,000	1,339	1,218	121
Fringe Benefits	54,030	55,443	55,185	258
Total General Fund	$ 519,844	$ 518,092	$ 514,525	$ 3,567

Schedule I-A

S.C. Sea Grant Consortium
State Development Grants
Year Ended June 30, 1991

Title	Grantee	Expenditures
College of Charleston Internship	CofC	$ 7,850
Sea Level Changes	USC	6,000
Sweetgrass Baskets	USC	1,000
Equipment Lease	SCWMRD	1,087
Xeriscape	CU	5,000
Radiocarbon & Tritium	USC	2,500
Internship	Governor's Office	1,981
Marine Rec Fishing Maps	LCOG	1,500
Skidaway Institute	Skidaway	3,000
State Aquaculture Conf*	In House	1,708
Lowcountry Science Fair	CofC	1,000
Chas Harbor Est After Hugo	CU	4,000
Terminal Project Proposal	CU	426
World Aqua Society '91	Texas A&M	300
Internal Waves & Larvae	CofC	4,700
Numerical Modeling	CU	8,000
SC Academy of Science	USC-Spartanburg	1,000
SC Aquaculture Fair	SC Crawfish Growers Assoc	500
Totals		$ 51,552

*Includes $600 for Postage

Schedule II-A

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1986-87
Year Ended June 30, 1991

	Sub-Contract
Development	$4,110

Sub-Contracts

Protection & Management Issues for S.C. Wetlands	Clemson	$2,500
Phytoplankton Ecology of Harbor after Hugo	CofC	1,000
Computer Search of Literature on Beach Processes	Clemson	500
Travel Support	USC	110
Totals		$4,110

Schedule II-B

S.C. Sea Grant Consortium
Statement of Changes in Sea Grant Contracts 1986-87
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Development	$	$ 4,110	$ 4,110	$

Schedule III-A

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1987-88
Year Ended June 30, 1991

	Salaries	Fringe Benefits	Contractual Services	Sub-Contracts	Total
Administration	$ 3,487	$ 833	$ 1,447	$	$ 5,767
Development				10,472	10,472
Total	$ 3,487	$ 833	$ 1,447	$ 10,472	$16,239

Sub-Contracts

Effects of Hurricane Hugo on Artificial Reefs	SCWMRD	$ 7,200
Hurricane Hugo Phytoplankton Ecology	CofC	3,200
Aquaculture Lenders Workshop	Clemson	72
Totals		$10,472

Schedule III-B

S.C. Sea Grant Consortium
Statement of Changes in Sea Grant Contracts 1987-88
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Administration		$ 5,767	$ 5,767	
Development		10,472	10,472	
Totals		$16,239	$16,239	

Schedule IV-A

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1988-89
Year Ended June 30, 1991

	Contractual	Sub Contracts	Supplies	Travel	Equipment	Total
Administration	$ 621	$	$ 21	$ 591	$	$ 1,233
Development	4,000	2,411	11			6,422
Communications			26		44	70
Totals	$ 4,621	$ 2,411	$ 58	$ 591	$ 44	$ 7,725

Sub-Contracts

Trends Analyses & Coastal Tourism in S.C.	Clemson	$1,327
Sweetgrass	USC	1,084
		$2,411

Schedule IV-B

S.C. Sea Grant Consortium
Statement of Changes in Restricted Expenditures
1988-89
Year Ended June 30, 1991

	Balance 7/1/91	Total Additions	Total Deductions	Balance 6/30/91
Administration		$ 1,233	$1,233	
Development		6,422	6,422	
Communications		70	70	
		$ 7,725	$7,725	

Schedule V-A

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1989-90
Year Ended June 30, 1991

	Salaries	Fringe Benefits	Contractual Services	Sub-Contracts	Supplies	Fixed Charges	Travel	Equip.	Total
Administration	$ 9,570	$ 1,301	$ 9,564	$ 2,160	$ 7,564	$	$ 3,611	$	$ 33,770
Development				15,200					15,200
Communications			13,128		1,915	204	59		15,306
Intern	12,000	2,026	5,032						19,058
Marine Ext. Program	7,058	2,624	3,574	66,605	1,060			5,904	86,825
Sub-Contracts				188,351					188,351
Sea Grant Abstracts			15,000						15,000
Totals	$ 28,628	$ 5,951	$46,298	$272,316	$10,539	$ 204	$ 3,670	$5,904	$373,510

Schedule V-A-1

S.C. Sea Grant Consortium
Sub-Contracts
Sea Grant 1989-90
Year Ended June 30, 1991

Title	Grantee	Expenditures
Applied Breeding of the Hard Clam	SCWMRD	$ 32,273
Applied Breeding of the Hard Clam	CofC	12,432
Applied Breeding of the Hard Clam	Clemson	14,631
Genetic Potential in the Hard Clam	USC	26,115
Assessment & Modeling Estuarine Flow	USC	28,522
Estuarine Nutrient Dynamics	USC	21,227
Intertidal Wetland Responses	USC	14,638
Anti-Scaling/Anti-Fouling Technology	Clemson	38,513
Totals		$188,351

Schedule V-A-2

S.C. Sea Grant Consortium
Development Funds
Sea Grant 1989-90
Year Ended June 30, 1991

Title	Grantee	Expenditures
Genetics of the Hard Clam	USC	$7,700
Genetics of the Hard Clam	USC	7,500
Totals		$15,200

Schedule V-A-3

S.C. Sea Grant Consortium
Marine Extension Program Sub-Contracts
Sea Grant 1989-90
Year Ended June 30, 1991

Title	Grantee	Expenditures
Marine Extension	SCWMRD	$ <3,287>
Marine Extension	Clemson	16,644
Marine Extension	Clemson	10,524
Marine Extension	SCWMRD	2,883
Marine Extension - Education	SCWMRD	14,278
Marine Extension	Clemson	25,563
		$ 66,605

Schedule V-B

S.C. Sea Grant Consortium
Statement of Changes in Restricted Funds
Sea Grant 1989-90
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Administration	$ 5,912	$ 27,858	$ 33,770	$
Development	602	14,598	15,200	
Communications	12,703	2,603	15,306	
Intern	869	18,189	19,058	
Marine Extension Program	4,350	82,475	86,825	
Sub-Contracts		188,351	188,351	
Sea Grant Abstracts		15,000	15,000	
	$ 24,436	$349,074	$373,510	$

Schedule VI-A

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1990-91
Year Ended June 30, 1991

	Salaries	Fringe Benefits	Contract. Services	Sub Contracts	Supplies	Fixed Charges	Travel	Equip	Total
Administration	$ 12,895	$ 1,947	$ 917	$	$ 3,895	$	$ 5,405	$	$ 25,059
Sea Grant Abstracts			55,000						55,000
Development			500	23,251					23,751
Communications	6,140	1,042	20,583		8,012	1,633	1,672	2,208	41,290
Marine Ext Program	27,563	4,498	5,591	65,123	4,943	129	2,673		110,520
Sub Contracts				163,144					163,144
Intern	6,000	459	4,969						11,428
NOS Workshop			1,200		14	323			1,537
Long Term Trends				7,054					7,054
Totals	$ 52,598	$ 7,946	$ 88,760	$258,572	$16,864	$2,085	$9,750	$2,208	$438,783

Schedule VI-A-1

S.C. Sea Grant Consortium
Sub-Contracts
Sea Grant 1990-91
Year Ended June 30, 1991

Title	Grantee	Expenditures
Applied Breeding of the Hard Clam	SCWMRD	$ 51,292
Applied Breeding of the Hard Clam	CofC	6,876
Applied Breeding of the Hard Clam	Clemson	15,943
Dietary Fatty Acids in Hybrid Striped Bass	Clemson	795
Estuarine Flow Transport	USC	32,322
Estuarine Nutrient Dynamics	USC	2,652
Intertidal Wetland Responses	USC	32,186
Hybrid Bass Tech to the Private Sector	SCWMRD	21,078
Totals		$163,144

Schedule VI-A-2

S.C. Sea Grant Consortium
Development Funds
Sea Grant 1990-91
Year Ended June 30, 1991

Title	Grantee	Expenditures
Genetics of the Hard Clam	USC	$ 3,690
Protein from Oyster Shells	Clemson	10,740
Chlorinated Phenolic Compound	USC	6,395
Charleston Estuary Plume & Ocean Front	Clemson	947
Numerical Modeling of Sediment Transport	Clemson	1,479
Totals		$23,251

Schedule VI-A-3

S.C. Sea Grant Consortium
Marine Extension Sub-Contracts
Sea Grant 1990-91
Year Ended June 30, 1991

Title	Grantee	Expenditures
Marine Extension Program - Education	SCWMRD	$16,661
Marine Extension Program	Clemson	38,133
Marine Extension Program	Clemson	10,329
Totals		$65,123

Schedule VI-B

S.C. Sea Grant Consortium
Statement of Changes in Restricted Grants
Sea Grant 1990-91
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Administration	$	$ 25,059	$ 25,059	$
Sea Grant Abstracts		55,000	55,000	
Development		23,751	23,751	
Communications		41,290	41,290	
Marine Ext. Program		110,520	110,520	
Sub-Contracts		163,144	163,144	
Intern		11,428	11,428	
NOS Workshop		1,537	1,537	
Long Term Trends		7,054	7,054	
Totals	$	$438,783	$438,783	$

Schedule VII-B

S.C. Sea Grant Consortium
Statement of Changes in Other Federal Funds
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
OCRM	$	$ 514	$ 514	$
NCRI		7,360	7,262	98
ACOE/Impoundment			2,863	<2,863>
Sweetgrass/NEA		8,400	8,400	
EPA	<120>	70		<50>
Coastal Impacts	<558>	4,000	2,096	1,346
Totals	$ <678>	$ 20,344	$ 21,135	$ <1,469>

Schedule VII-A

S.C. Sea Grant Consortium
Schedule of Other Federal Expenditures
Year Ended June 30, 1991

	Salaries	Fringe Benefits	Contractual	Sub Contracts	Supplies	Total
OCRM	$	$	$	$ 514	$	$ 514
NCRI			54	7,208		7,262
ACOE/Impoundment	1,865	313			685	2,863
Sweetgrass/NEA			8,400			8,400
EPA						
Coastal Impacts			1,625		471	2,096
Totals	$ 1,865	$ 313	$ 10,079	$ 7,722	$1,156	$21,135

Schedule VIII-A

S.C. Sea Grant Consortium
Schedule of Other Restricted Expenditures
Year Ended June 30, 1991

	Salaries	Fringe Benefits	Contractual Services	Sub Contracts	Supplies	Equipment	Total
Sale of Assets	$	$	$	$	$	$	$
Bird Guide	1,087	83	316	4,331	9		5,826
Beach/River Sweep	2,210	153	3,432		1,815		7,610
Communications Reprints							-0-
Public Awareness			16		484		500
PICMD Caribbean							-0-
Recycling Guide			12				12
Undersea SC '90			887				887
CPW Pipeline				50,010		2,650	52,660
Hybrid Bass Wkshp							-0-
Donations Misc			42		436		478
Harborwatch					340		340
SAMP					214		214
WR-4 Education	8,000	1,322					9,322
Wetlands Ed Materials							-0-
Econ Via - St. Kitts							-0-
PICMD-Donation							-0-
Hybrid Bass Donation				21,498			21,498
GCFI	3,454	474			507		4,435
PRT-Folly Beach							-0-
Shrimp Workshop			4,249				4,249
Dual Employment	3,145	892					4,037
Totals	$ 17,896	$2,924	$ 8,954	$75,839	$ 3,805	$ 2,650	$112,068

Schedule VIII-B

S.C. Sea Grant Consortium
Statement of Changes in Other Restricted Funds
Year Ended June 30, 1991

	Balance 7/1/90	Total Additions	Total Deductions	Balance 6/30/91
Sale of Assets	$ 1,730	$ 3,290	$	$ 5,020
Bird Guide	12,813	7,795	5,826	14,782
Beach Sweep/River Sweep	6,586	9,326	7,610	8,302
Communications Reprints	3,029	289		3,318
Public Awareness/Jr League	500		500	
PICMD - Caribbean	9			9
Recycling Guide	185		12	173
Undersea SC '90	887		887	
CPW Pipeline	53,991		52,660	1,331
Hybrid Bass Workshop	232			232
Donations-Miscellaneous		5,050	478	4,572
Harborwatch		500	340	160
SAMP			214	<214>
WR4-Education		15,000	9,322	5,678
Wetlands Ed Materials	18			18
Econ Viability St. Kitts	3,147	<3,147>		
PICMD-Donation	279			279
Hybrid Bass Donation	87,702	1,750	21,498	67,954
GCFI	4,109	1,833	4,435	1,507
PRT - Folly Beach	8			8
Shrimp Workshop	4,249		4,249	
Dual Employment		5,487	4,037	1,450
Totals	$179,474	$ 47,173	$112,068	$114,579

Total Number of Documents Printed	255
Cost Per Unit	$ 2.11
Printing Cost - S.C. State Budget & Control Board (up to 255 copies)	$ 537.64
Printing Cost - Individual Agency (requesting over 255 copies)	$ –
Total Printing Cost	$ 537.64